DOCUMENT RESUME

ED 261 422 CS 505 023

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TITLE Developmental Differences in Children's Television Story Comprehension: Effects of Content Cues and Auditory Formal Production Features.
PUB DATE May 85
NOTE 35p.; Paper presented at the Annual Meeting of the International Communication Association (35th, Honolulu, HI, May 23-27, 1985). Funding provided by grants from the Home Economics Center for Research and the University of North Carolina at Greensboro Summer Faculty Research Excellence Program and the Research Council.
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cognitive Processes; *Comprehension; *Cues; Elementary Education; Listening Comprehension; Recall (Psychology); *Retention (Psychology); *Sound Effects; Television; *Visual Learning

ABSTRACT

In a study conducted to measure children's visual attention to a television program and relate it to comprehension of content, 64 children equally distributed by sex from kindergarten and fifth grade, were randomly assigned to one of four treatment conditions. These conditions crossed two levels of content cues with two levels of sound effects before and after a dream segment in the program. The content cue condition provided 20 seconds of supplementary information, which indicated that a dream was occurring while the no content cue condition did not. The content/no content cue conditions were either preceded or not preceded by a sound effect which marked these program transitions. Visual attention was videotaped during each child's individual viewing session. After viewing, each child answered a 22 item multiple-choice recognition test of inferential, central-concrete, and incidental information and then ordered picture sets of events photographed from the awake, dream, and whole program segments. Results showed that sound effects improved attentional interest and inferential recognition for kindergarten and the picture sequencing of the awake segment for fifth graders. All children sequenced more pictures correctly from the awake segment when content cues were present. (DF)

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Developmental Differences in Children's Television Story Comprehension: Effects of Content Cues and Auditory Formal Production Features

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Running Head: SOUND EFFECTS AND TV STORY COMPREHENSION

Paper presented at the International Communication Association, Honolulu, May, 1985.
This research was supported by grants from the Home Economics Center for Research, the University of North Carolina at Greensboro Summer Faculty Research Excellence Program, and the University of North Carolina at Greensboro Research Council. We are grateful to the staff and children of Vandalia Elementary School, and to Garrett W. Lange, Robert E. Nida, Frances Moran, Lynn Hinton, and Paul Whitener for their assistance. Requests for reprints should be directed to Sandra L. Calvert, Children and Technology Project, Department of Child Development and Family Relations, University of North Carolina at Greensboro, Greensboro, North Carolina, 27412.

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Abstract

Children's visual attention to the same television program was measured and related to comprehension of content. Four treatment conditions crossed two levels of content cues with two levels of sound effects before and after a dream segment. The content cue condition provided 20 seconds of supplementary information which indicated that a dream was occurring while the no content cue condition did not. The content/no content cue conditions were either preceded or not preceded by a sound effect which marked these program transitions. Sixty-four children, equally distributed by sex and by kindergarten and fifth grades, were randomly assigned to one of the four treatment conditions. Visual attention was videotaped during each child's individual viewing session. After viewing, each child answered a 22 item multiple-choice recognition test of inferential, central-concrete, and incidental information and ordered picture sets of events photographed from the awake, dream, and whole program segments. Sound effects improved attentional interest and inferential recognition for kindergartners and picture sequencing of the awake segment for fifth graders. All children sequenced more pictures correctly from the awake segment when content cues were present rather than absent, but kindergartners recognized inferential information better in no content cue conditions. While it has been argued that content is more important for mature comprehension than are formal production features like sound effects, this study demonstrated that sound effects increased attentional responsiveness and story comprehension better than supplementary content cues.

Developmental Differences in Children's Television Story Comprehension: Effects of Content Cues and Auditory Formal Production Features

Mature comprehension of a televised story requires a viewer to deploy attention effectively, to temporally integrate program material, and to draw inferences about information that is never explicitly presented (Collins, Wellman, Keniston & Westby 1978). Because a young child's attentional patterns are insufficiently developed for mature information selection, an initial step in improving television story comprehension may be to guide visual attention selectively to important content. Content per se does not reliably get a child who is not looking to attend to a television program, but certain auditory television production features do reliably elicit an attentional orienting response (Anderson & Levin 1976; Calvert, Huston, Watkins & Wright 1982). This study examines how sound effects, an auditory formal production feature, can guide a child's visual attention to content cues so that story comprehension is increased.

Formal features are visual and auditory production techniques that structure, mark, and represent televised content. Using Berlyne's (1960) collative variables of motion, novelty, incongruity, intensity, change, and the like, Wright and Huston (1983) classified certain formal features as perceptually salient. For example, the novelty of a sound effect in television presentations results in

attentional interest, particularly by younger, less experienced viewers. With age and experience, viewers are expected to habituate to perceptual salience unless such features are markers of meaningful content. Perceptually salient features, then, serve to increase attention initially because they produce a primitive orienting response by a child.

Attention is necessary, but not sufficient, for effective comprehension (Huston & Wright 1983). Even if sound effects can guide a child's initial selection of story content by marking certain information for further processing, a child must still understand that information. Central content that is explicitly presented is easier to understand than is implicitly presented content that has to be inferred (Collins 1982). If the implicit relations between story events were concretely depicted, then perhaps story comprehension would be increased.

Salomon (1981) argues that the amount of invested mental effort (AIME) that a child expends to understand a television program depends on the match between a child's cognitive skills and the information processing demands of the presentation. On the one hand, providing additional content to bridge television program transitions could assist a young child's inferential story comprehension by supplying a skill that is not well developed. On the other hand, supplementary content could actually interfere with effective comprehension because a child is less challenged to think about the connections between story events, thereby leading to shallow information

processing. Because older children have greater skill to think beyond the information given than do younger children (Bruner, Olver & Greenfield 1966), supplying additional content cues should assist younger, less skillful viewers more than older, skillful viewers.

The purpose of this study was to examine whether or not sound effects could increase visual attention to, and subsequent comprehension of, continuously presented televised story content. The content was presented with or without supplementary cues about implicit relations between story events. The major hypotheses were that: 1) Younger children who were not looking at the television program would attend to sound effects more than older children; 2) Younger children's comprehension would be increased more than older children's when sound effects preceded significant content; 3) Older children would show less dependence on sound effects for effective comprehension than would younger children; and 4) Content cues would assist younger children's comprehension more than older children's.

Method

Subjects

The sample consisted of 64 children who attended a Southeastern public primary school. Children were equally distributed by sex and by kindergarten and fifth grades.

Procedure

Each child entered a room at school and was seated at a table with an experimenter. Small toys, comic books, and other toys were available for play. The experimenter told each child to read, play,

and watch television as at home. The experimenter then used two remote control buttons to simultaneously activate: 1) a camera which videotaped the viewing session; and 2) a videotape recorder which played one of four edited versions of a children's television program.

The television program was a 14 minute black and white, live episode of "The Little Rascals." The program series focused on the adventures of a group of young children and their leader, Spanky. This particular episode was titled "Mama's Little Pirates." In the plot, Spanky and his friends decided to search for pirate treasure in a cave. Spanky returned home for a flashlight so that they could see. When Spanky's mom found out about the plan, she refused to let him return to the cave because it could be dangerous. Spanky insisted on returning, and his mom sent him to his room until he learned to obey her.

A scene shift from realistic story events to a dream segment subtly moved Spanky from a verbal reverie in his bedroom to a dream about treasure hunting in a cave. In the dream, the children found a large treasure chest, but their good fortune was thwarted when they got lost in the cave and found themselves in a giant's house. The giant discovered them and chased them for stealing his treasure. While Spanky was running from the giant, he remembered the warnings of his mother and of his friend about the dangers of the cave. Spanky then awakened in his own bed. His friends were at his bedroom window asking him whether or not he wanted to return to

the cave.

Children were randomly assigned within age and sex groups to one of four treatment conditions. In all four conditions, the program plot was retained. The experimental modifications crossed two levels of content cues with two levels of sound effects before and after the dream segment. When content cues were present, information was provided to show that Spanky was dreaming; in particular, the dream segment was edited to make Spanky get into his bed and lay his head down to go to sleep before the dream, and later he awakened in his bed. When content cues were absent, such cues were not provided. The content/no content cue dimension was either preceded or not preceded by sound effects in order to call attention to the scene shifts. Thus, the four experimental conditions were 1) no content cues and no sound effects; 2) no content cues and sound effects; 3) content cues and no sound effects; and 4) content cues and sound effects. The length of the four treatment conditions was 13.11, 13.12, 13.47, and 13.47 minutes, respectively.

Visual Attention

The camera videotaped each child's visual orientation to the television screen. These tapes were later scored to determine the probability that sound effects would recruit a child's attention back to the television program if he was not looking. Visual attention was scored as "recruited" when a child reoriented attention back to the television screen within 5 seconds after the sound effects occurred or during that same time frame in no sound effect conditions;

visual attention was scored as "not recruited" if a child did not reorient attention back to the television screen within that 5 second frame.

Interobserver agreement was computed by having two independent observers score the same children. Agreement occurred when both observers scored an onset or offset of attention within 5 seconds after the sound effect was presented or during that same program time frame for the no sound effect conditions. Reliability was 97% using the formula of 2 x the number of agreements divided by the total number of scores for both observers.

Comprehension

After viewing, each child answered two types of comprehension measures: multiple choice and picture sequencing.

Multiple-Choice Recognition Scores. The multiple-choice recognition test measured a child's comprehension of program content while controlling for possible age differences in verbal ability. To construct multiple-choice test items, two adult judges who were familiar with the program first identified central and incidental story events and put those events into an open-ended questionnaire. Central content was defined as plot-essential information whereas incidental content was defined as information that was peripheral to the plot. The questionnaire was then completed by 42 adults who viewed the program, rated each question as central or incidental to the plot, and answered each question. Central questions were classified as either

concretely presented facts or as implicitly presented inferences about character feelings and motives. Incidental questions contained humorous information as well as irrelevant program details.

To construct multiple-choice alternatives, three incorrect verbal responses were taken from the open-ended questionnaires. Each multiple-choice question was supplemented by a relevant photograph from the program at the point where information was presented that was necessary to answer the question. There were 7 inferential items, 5 central-concrete items, and 10 incidental items. An example of an inferential item was "What lesson does Spanky learn? A) To listen to his mom; B) To listen to himself; or C) Not to dump cereal in his dad's bowl." An example of a central-concrete item was "Why does Spanky's mom tell him not to go into the cave? A) Because it was too dark; B) Because it was dangerous; or C) Because a giant lived there." An incidental item was "How did Spanky leave the breakfast table? A) By sneaking out behind his mother; B) By saying 'Excuse me'; or C) By crawling under the table.

Each child answered the resultant 22 item multiple-choice recognition measure which consisted of a picture, a question, and three response options. The items were arranged randomly within one book. The experimenter read each question aloud, pointing to alternatives that were color-coded as a red "A", a blue "B", or a green "C". The child pointed to a response option and turned the pages of the book as the experimenter circled the child's response choices on an answer sheet.

Picture Sequence Scores. To assess temporal integration of the plot line, each child ordered three sets of six events photographed from the television program. The first picture set represented events from the whole program and included three events that occurred while Spanky was dreaming and three events that occurred while Spanky was awake. The second and third picture sets represented only events that occurred when Spanky was either awake or dreaming, respectively.

For each picture set, the experimenter randomly arranged the six photographs in two rows and gave the following instructions: "Here are some pictures of things that happened in the story. I'd like you to put these pictures in order from the first thing that happened in the story to the last in a line right in front of you," (experimenter drew a straight line from left to right with her finger). After a child had ordered a set of photographs, the experimenter said either: "Now tell me what happened in the story," or "Tell me what happened in this part of the story." After a child finished telling the story, the experimenter picked up the pictures from left to right and then gave the child the next set of pictures. As the child sequenced the next picture set, the experimenter unobtrusively recorded the child's picture order of the previous set from numbers on the backside of the pictures.

For each of the three picture sets, a picture sequence score was calculated for each child by comparing the child's picture order to

its correct absolute position and to the number of correctly sequenced adjacent picture pairs. To calculate this score, the pictures were correctly ordered from 1 to 6. For each picture, one point was awarded for every picture with a lower number placed to its left. In addition, one point was awarded for each correct adjacent pair of pictures. The total picture sequence scores were calculated by adding the two parts, resulting in a maximum possible score of 20. This scoring method is correlated +.89 with the rank-order correlation (rho) between obtained and correct sequences, but gives more credit for correct adjacent picture pairs (cf., Wright, Huston, Ross, Calvert, Rolandelli, Weeks, Raessi & Potts 1984). The total session for each child was approximately one hour.

Results

Seven dependent measures were analyzed. Recruit attention scores computed the percent of time that an inattentive child would look at the television screen within 5 seconds after the sound effects were or were not presented. Three dependent measures were derived from multiple-choice recognition questions: the number of correct responses to inferential, central-concrete, and incidental items. Three dependent measures were derived from picture sequencing that represented how well each child ordered the awake, dream, and whole program segments, respectively. Each dependent measure was analyzed, in turn, by a 2 (sound effect) by 2 (content cue) by 2 (grade) by 2 (sex) between-subjects analysis of variance. Duncan's multiple-range follow-up test was used for all post-hoc comparisons.

Recruit Attention Scores

The four factor ANOVA computed on recruit attention scores yielded main effects for scund effects, F (1, 48) = 29.21, $p < .05$, and grade, F (1,48) = 4.86, $p < .05$, which were qualified by a grade by sound effect interaction, F (1,48) = 6.78, $p < .05$. Children who heard sound effects deployed their attention back to the television program 44% of the time while children in no sound effect conditions were recruited back only 2% during that same time frame. Kindergartners' attention was recruited back to the television program 31% of the time while fifth graders attention was recruited only 14% of the time. As expected, kindergartners were significantly more responsive to sound effects than were fifth graders, partly because fifth graders were more likely than were kindergartners to be looking at the program points where sound effects were placed, indicating that the older children did not need sound effects for mature attentional deployment. Kindergartners reoriented attention back to the television program 62% of the time after hearing sound effects, but they reoriented attention 0% of the time when there were no sound effects; fifth graders reoriented back to the television program 25% of the time after hearing sound effects, but they reoriented attention only 3% of the time when there were no sound effects. Thus, kindergartners gained substantial attentional benefit from sound effects, while 5th graders did not need them.

Comprehension of Content

The four factor ANOVA computed on inferential recognition scores

yielded main effects for grade, F (1,48) = 91.35, $p < .001$, and for sound effects, F (1,48) = 4.28, $p < .05$, which were qualified by a grade by sound effect interaction, $F(1,48) = 5.14$, $p < .05$, and by a grade by content cue interaction F (1,48) = 5.14, $p < .05$. Fifth graders recognized 5.72 inferential items while kindergartners recognized only 2.69 items. Children who heard sound effects recognized 4.53 inferential items while those who did not hear sound effects recognized 3.88 items. Condition effects for inferential recognition occurred only at the kindergarten level. As seen in Figure 1, the grade by sound

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Insert Figure 1 about here

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effect interaction revealed that sound effects increased kindergartners inferential recognition while fifth graders recognized inferential content equally well in both conditions. The grade by content cue interaction revealed that kindergartners recognized inferential content better in no content cue (mean = 3.25) than in content cue (mean = 2.13) conditions while fifth graders recognized inferential content equally well in both no content cue (mean = 5.76) and content cue (mean = 5.88) conditions.

The four factor ANOVA on central-concrete recognition scores yielded a main effect for grade, $F(1,48) = 31.50$, $p < .001$, and a sex by sound effect interaction, $F(1,48) = 5.79$, $p < .05$. Fifth graders recognized 4.53 central-concrete items while kindergartners recognized 3.22 items. Boys in no sound effect conditions (mean =

4.25) recognized significantly more central-concrete content than did girls in no sound effect conditions (mean = 3.44) whereas boys (mean = 3.75) and girls (mean = 4.06) in sound effect conditions did not differ from other conditions in central-concrete recognition.

The four factor ANOVA computed on incidental recognition scores yielded only a main effect for grade, F (1,48) = 12.80, $p < .001$. Fifth graders recognized 6.50 incidental items while kindergartners recognized 5.06 items.

Comprehension of Temporal Sequences

The four factor ANOVA computed on awake picture sequencing scores yielded main effects for content cues, F (1,48) = 4.10, $p < .05$, and grade, $F(1,48) = 45.05$, $p < .001$, as well as a grade by sound effect interaction, $F(1,48) = 6.00$, $p < .05$. As expected, children sequenced more pictures correctly from the awake segment in content cue (mean = 15.22) than in no content cue (mean = 13.44) conditions. Fifth graders sequenced 17.28 pictures correctly on the awake segment while kindergartners sequenced only 11.38 pictures correctly. As seen in Figure 2, the grade by

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Insert Figure 2 about here

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sound effect interaction revealed that fifth graders in sound effect conditions sequenced more pictures correctly on the awake segment than did fifth graders in no sound effect conditions; this effect was not present for kindergartners.

The four factor ANOVA computed on dream picture sequence scores yielded a main effect for grade, F (1,48) = 45.05, $p < .001$, and a grade by sex interaction, F (1,48) = 7.44, $p < .01$. Fifth graders sequenced 19.19 pictures correctly while kindergartners sequenced only 13.03 pictures correctly. The grade by sex interaction indicated that kindergartner girls sequenced more pictures correctly than did kindergartner boys for the dream segment; there were no sex differences at the fifth grade level. The means for kindergartners were 14.38 for girls and 11.69 for boys while the means for fifth graders were 18.38 for girls and 20.00 for boys.

The four factor ANOVA on whole program sequencing yielded only a main effect on grade, F (1,48) = 27.74, $p < .001$. Mean scores for whole program sequencing were 18.13 for fifth graders and 13.94 for kindergartners.

Discussion

The major focus of this study was to examine how sound effects, an auditory formal feature, can guide a child's visual attention selectively to significant televised content, thereby improving story comprehension. As expected, kindergartner's who were not looking at the television program reoriented their attention back to the television program immediately after they heard sound effects, but this effect was not present for fifth graders. More importantly, both age groups rarely reoriented their attention back to the television program when sound effects were not presented. These developmental

differences in attentional preferences suggest that the younger children were attracted by the perceptual salience of sound effects whereas the older children no longer relied on perceptual salience to make attentional decisions. Thus, sound effects enhanced the first link in the information processing chain--getting a young child to attend selectively to significant story content.

Not only did sound effects enhance attentional interest to important story events, but comprehension was also increased. Sound effects assisted younger children's inferential comprehension, but older children did not require such highlighting for mature comprehension. Inferential comprehension requires a viewer to integrate information across scene changes. Kindergartners who heard sound effects were more likely to see these scene changes and to incorporate that information into their story schemes because the transitions were marked for further processing. Wright, Calvert, Huston-Stein and Watkins (1980) found that older children were more likely to make attentional discriminations at scene changes than were younger children. This study adds to the body of literature by demonstrating that attention during scene changes resulted in better inferential story comprehension by young viewers, thereby providing a link between selective attention to television forms and children's comprehension of content.

Sound effects also had positive effects on fifth grader's comprehension. Sequencing the awake segment was facilitated for fifth graders who heard sound effects, suggesting that the sound effects

were used by older viewers as a way to chunk the story into sections.

Although sound effects did not increase central-concrete comprehension, the absence of sound effects led to poorer comprehension among girls than among boys. Thus, adding sound effects to the story eliminated sex differences in comprehending the central-concrete content.

Perceptually salient features have been said to enhance comprehension of irrelevant material, yet sound effects had no effect on incidental comprehension. When central material was marked for processing, then central comprehension increased. Perhaps incidental comprehension would be increased if sound effects were paired with irrelevant story material. The type of content highlighted by sound effects is the key variable, for such production decisions mark certain content for further processing.

While much of the past literature emphasizes the importance of content for mature comprehension (Anderson, Lorch, Field & Sanders 1981; Collins 1982), this study demonstrated variable results for additional supplementary content cues. Content cues had no effect on visual attention, central-concrete comprehension, incidental comprehension, and sequencing of either the dream or whole program segments. Content cues had a positive effect for sequencing the awake segment. However, content cues negatively affected kindergartner's inferential comprehension, a key variable for mature story comprehension.

Salomon's (1981) concept of AIME may best describe why content

cues had differential effects on comprehension. Picture sequencing was a relatively more concrete task than was inferential recognition as ordering pictures was more of a visual than a verbal task. Skill at ordering visually presented story events may be best facilitated by providing additional content cues because it requires little mental effort by a child. By contrast, inferential comprehension may be best facilitated when a child exerts mental effort. When content cues were not presented, a viewer was called upon to go beyond the information given and infer that content whereas the presence of such content cues may have resulted in less active processing. Consequently, calling upon a viewer to think about program material may well be a good strategy for facilitating inferential reasoning.

Another possible reason that the content cue manipulation had limited and even negative effects on comprehension was the brief amount of supplementary content that was presented. Twenty seconds of additional content may not have been sufficient to enhance comprehension, especially if a child was not looking. However, attentional deficits are not an adequate explanation for the lack of findings because sound effects did precede and mark content cues in one condition. It seems more likely that comprehension tasks are facilitated differentially based on the information processing requirements of specific tasks.

In summary, sound effects increased kindergartner's attentional responsiveness which resulted in better inferential recognition; sound effects also increased fifth grader's sequencing of story

events. However, sound effects had no relation with comprehension of irrelevant, incidental program details. The selective use of sound effects to mark critical program content is a cost-effective way for producers to improve children's television programs, particularly for those young viewers who have the most difficulty in understanding televised stories.

By contrast, content cues had few effects on attention or comprehension, and the effects that occurred were mixed. Content cues positively effected sequencing of story events, but negatively effected kindergartner's inferential comprehension. While it has been argued that content is more important for mature comprehension than are formal production features like sound effects, this study demonstrated that sound effects increased attentional responsiveness and story comprehension better than the supplementary content cues.

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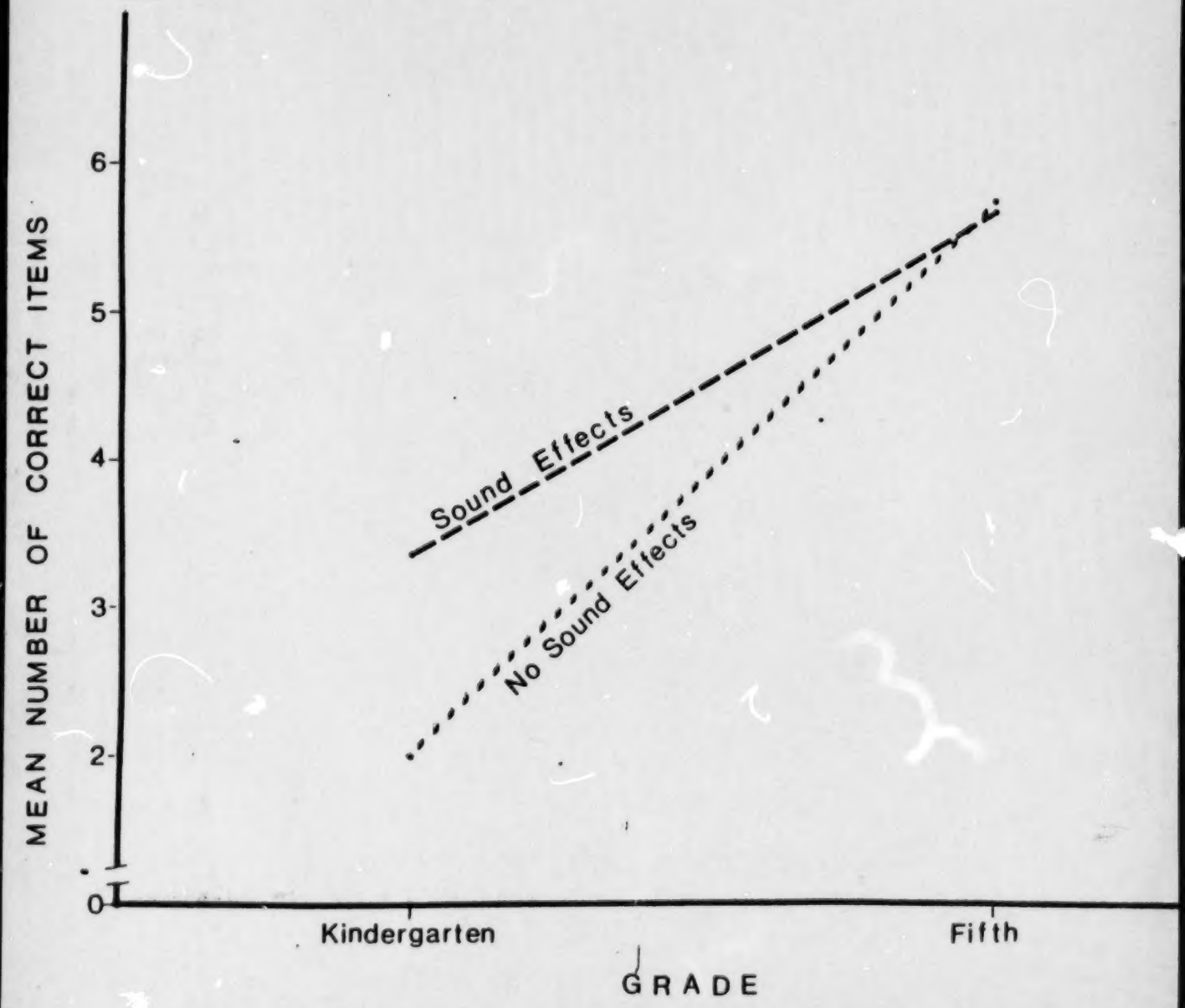
Figure Captions

Figure 1. Developmental differences in mean number of inferential items correct as a function of sound effects.

Figure 2. Developmental differences in mean number of correctly sequenced pictures from the awake segment as a function of sound effects.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4
3
2
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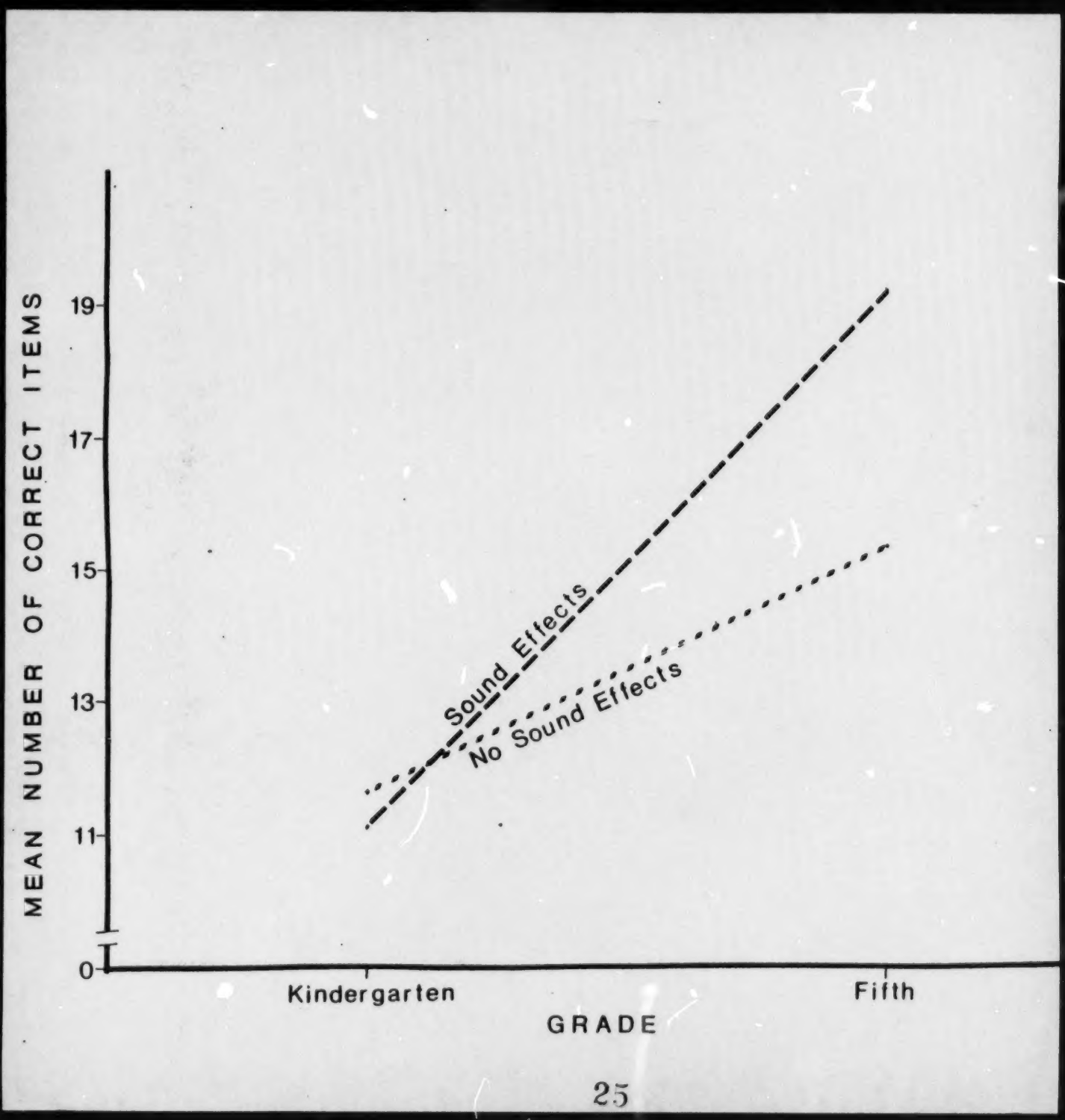
Sound Effects
No Sound Effects
Kindergarten
Fifth
GRADE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17
15
13
11
0
Sound Effects
No Sound Effects
Kindergarten
Fifth
GRADE